U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

OFFICE OF NUCLEAR REACTOR REGULATION

9.3.4 CHEMICAL AND VOLUME CONTROL SYSTEM (PWR) (INCLUDING BORON RECOVERY SYSTEM)

REVIEW RESPONSIBILITIES

Primary - Materials and Chemical Engineering Branch (~~CMEB~~ EMCB[1])

Secondary - Plant Systems Branch (SPLB)
Reactor Systems Branch (SRXB)[2]

I. AREAS OF REVIEW

Pressurized water reactor (PWR) plants include a chemical and volume control system (CVCS) and boron recovery system (BRS). These systems maintain the required water inventory and quality in the reactor coolant system (RCS), provide seal-water flow to the reactor coolant pumps and pressurizer auxiliary spray, control the boron neutron absorber concentration in the reactor coolant, and control the primary water chemistry and reduce coolant radioactivity level. Further, the system provides recycled coolant for demineralized water makeup for normal operation and the design may also provide high pressure injection flow to the emergency core cooling system (ECCS) in the event of postulated accidents. The review is performed to assure conformance with the requirements of General Design Criteria (GDC) 1, 2, 5, 14, 29, 33, 35, 60, and 61. In addition, the CVCS system may provide reactor coolant inventory control and/or reactor coolant pump seal injection necessary for withstanding or coping with a station blackout. The CVCS system capability to perform these functions is reviewed as necessary to assure conformance with 10 CFR 50.63(a)(2).[3]

The ~~CMEB~~ EMCB[4] reviews the systems from the letdown line of the primary system to the charging lines that provide makeup to the primary system and the reactor coolant pump seal-water system. The system is reviewed to the interfaces with the demineralized water makeup system and radioactive waste system and includes the following considerations:

1. The safety-related functional performance characteristics of CVCS components and the effects of adverse environmental occurrences, abnormal operational requirements, or accident conditions such as those due to a loss-of-coolant accident (LOCA).

2. The determination that a malfunction, a single failure of an active component, or the loss of a cooling source will not reduce the safety-related functional performance capabilities of the system.

3. That quality group and seismic design requirements are met and the effects of failure of equipment or components not designed to withstand seismic events on safety-related functions of the system are evaluated.

4. The system features provided to prevent precipitation of boric acid in components and lines containing boric acid solutions, and the adequacy of the system design to protect personnel from the effects of toxic, irritating, or explosive chemicals that may be used.

5. Provisions for operational testing and the instrumentation and control features that determine and verify that the system is operating in the correct mode.

6. The system provisions to prevent the formation of vacuum conditions in tanks that can contain primary system water.[5]

~~B. The review for fire protection is performed by CMEB in SRP Section 9.5.1.~~[6]

Review Interfaces:[7]

~~Coordinated reviews that interface with the overall review of the CVCS by CMEB are performed by other branches as follows.~~ The EMCB will coordinate with other branches' evaluations and reviews that interface with the overall review of the system as follows:[8]

1. The Plant Systems Branch (SPLB) performs the following reviews:

   a. The ~~ASB~~ SPLB ~~also~~[9] evaluates the capability of the CVCS to withstand external and internal flood conditions as part of its primary review responsibility for SRP Sections 3.4.1 and 9.3.3.

   b. The ~~ASB~~ SPLB ~~also~~[10] evaluates the capability of internally generated missiles both inside and outside primary containment as part of its primary review responsibility for SRP Sections 3.5.1.1 and 3.5.1.2.

   c. The ~~ASB~~ SPLB ~~also~~[11] evaluates the capability of safety-related systems to withstand the effects of missiles generated by natural phenomena or externally

generated missiles as part of its primary review responsibility to SRP Sections 3.5.1.4 and 3.5.2.

d. The ~~Auxiliary Systems Branch (ASB)~~ SPLB[12], as part of its primary review responsibility for SRP Section 3.6.1, evaluates the effect of high- and moderate-energy CVCS system piping failures outside containment to assure that other safety-related systems will not be made inoperable.

e. The SPLB reviews the environmental qualification of mechanical and electrical safety-related equipment as part of its primary review responsibility for SRP Section 3.11.[13]

f. The SPLB evaluates the effect of cooling water system failures on reactor coolant pump seal integrity as part of its primary review responsibility for SRP Section 9.2.2.[14]

g. The SPLB reviews the CVCS system with respect to fire protection as part of its primary review responsibility for SRP Section 9.5.1.[15]

h. The liquid, solid, and gaseous waste treatment ~~and process and effluent radiological monitoring~~ aspects of the CVCS are reviewed in SRP Sections 11.2, 11.3, and 11.4, ~~and 11.5,~~ respectively, by the ~~Effluent Treatment Systems Branch (ETSB)~~ SPLB[16] as part of its primary review responsibility for those sections.

2. The Reactor Systems Branch (SRXB) performs the following reviews:

a. As part of its primary review responsibility for SRP Section 3.12 (proposed), the SRXB reviews the CVCS to verify that low-pressure portions of the CVCS that interface with the RCS are designed, to the extent practical, to withstand full RCS pressure. If designing the CVCS with an ultimate rupture strength capable of withstanding full RCS pressure is not possible, the reviewer verifies that appropriate compensating measures have been taken in accordance with the review provided in SRP Section 3.12 (proposed).[17]

b. The ~~Core Performance Branch (CPB)~~ SRXB[18] evaluates the injection of borated water into the RCS to meet combined reactivity control system redundancy and capability requirements of GDC 26 and 27 as part of its primary review responsibility for SRP Section 4.3.

c. The ~~Reactor Systems Branch (RSB~~ SRXB[19]~~)~~ reviews the CVCS flow capacity and injection pressure to verify that specified acceptable fuel design limits are not exceeded following a postulated LOCA in evaluating the ECCS function as part of its primary review responsibility for SRP Sections 6.3, 15.6.1, and 15.6.5.

d. ~~RSB~~The SRXB[20] also reviews CVCS malfunctions that can result in a decrease in boron concentration in the reactor coolant to assure that fuel damage limits are not exceeded and that adequate time is available to terminate the dilution before

the shutdown margin has been eliminated as part of its primary review responsibility for SRP Section 15.4.6.

3. The Emergency Preparedness and Radiation Protection Branch (PERB) performs the following reviews:

   a. The process and effluent radiological monitoring aspects of the CVCS are reviewed in SRP Section 11.5 by the PERB as part of its primary review responsibility for that section.[21]

   b. The ~~Radiation Assessment Branch (RAB),~~PERB[22] as part of its primary review responsibility for SRP Sections 12.1 and 12.3, reviews the system with respect to maintaining occupational radiation exposure as low as reasonably achievable (ALARA) and to providing radiation protection design features, respectively.

4. The ~~Instrumentation and Control Systems Branch (ICSB)~~ Instrumentation & Controls Branch (HICB)[23] ~~and the Power Systems Branch (PSB)~~evaluates the adequacy of the design, installation, inspection, and testing of all instrumentation, sensing, and controls required to provide the safety-related functions of the CVCS as part of its primary review responsibility for SRP Sections 7.1, 7.6, and Appendix 7A.[24]

5. The Electrical Engineering Branch (EELB)[25] evaluates the adequacy of the design, installation, inspection, and testing of all electrical systems ~~(sensing, control, and power)~~ required to provide the safety-related functions of the CVCS as part of its~~their~~ primary review responsibility for ~~SRP Sections 7.1, 7.6, and Appendix 7A for ICSB and~~SRP Sections 8.3.1 and 8.3.2. ~~for PSB~~ [26] In addition, as part of its primary review responsibility for SRP Section 8.4 (proposed), the EELB reviews the plant's overall capabilities to withstand or cope with, and recover from a Station Blackout (SBO) as required by 10 CFR 50.63.[27]

6. The ~~Structural Engineering Branch (SEB)~~ Civil Engineering and Geosciences Branch (ECGB)[28] determines the acceptability of the design analysis, procedures, and criteria used to establish the ability of seismic Category I structures housing the system and supporting systems to withstand the effects of natural phenomena, such as the safe shutdown earthquake (SSE), the probable maximum flood (PMF), and tornado missiles as part of its primary review responsibility for SRP Sections 3.3.1, 3.3.2, 3.4.2, 3.5.3, 3.7.1, 3.7.2, 3.7.3, 3.8.4, and 3.8.5. The ~~Materials Engineering Branch (MTEB~~ECGB[29]~~)~~ also verifies that inservice nondestructive examination requirements are met for system components as part of its primary review responsibility for SRP Sections 5.2.4 and 6.6.[30]

7. The Mechanical Engineering Branch (EMEB) performs the following reviews:

   a. The ~~Mechanical Engineering Branch (MEB~~ EMEB[31]~~)~~ determines the acceptability of the seismic and quality group classifications for systems components as part of its primary review responsibility for SRP Sections 3.2.1 and 3.2.2.

b. The ~~MEB~~ EMEB ~~also~~[32] determines that the piping, components, and structures are designed in accordance with applicable codes and standards as part of its primary review responsibility for SRP Sections 3.9.1, 3.9.2, and 3.9.3.

c. The ~~MEB~~ EMEB ~~also~~[33] reviews the adequacy of the inservice testing program of pumps and valves as part of its primary review responsibility for SRP Section 3.9.6.

d. The ~~Equipment Qualification Branch (EQB)~~ EMEB[34] reviews the seismic qualification of Category I instrumentation and electric equipment ~~and the environmental qualification of mechanical and electrical safety-related equipment~~ as part of its primary review responsibility for SRP Sections 3.10 ~~and 3.11, respectively~~.[35]

8. The Containment Systems and Severe Accident Branch (~~CSB~~SCSB[36]) reviews the design of isolation provisions of those portions of the CVCS that penetrate primary containment as part of its primary review responsibility for SRP Section 6.2.4.

9. The review for technical specification~~s and quality assurance are~~is coordinated and performed by the ~~Licensing Guidance Branch (LGB)~~ Technical Specifications Branch (TSB)[37] ~~and Quality Assurance Branch (QAB)~~ as part of ~~their~~its primary review responsibility for SRP Section~~s~~ 16.0~~, 17.1, and 17.2, respectively~~.[38]

10. The review of quality assurance is coordinated and performed by the Quality Assurance and Maintenance Branch (HQMB) as part of its primary review responsibility for SRP Sections 17.1 through 17.4 (proposed).[39]

For those areas of review identified above as being reviewed ~~as part of the primary review responsibility of~~under other SRP sections~~branches~~, the acceptance criteria necessary for the review and their methods of application are contained in the referenced SRP sections ~~of the corresponding primary branch~~.[40]

II. ACCEPTANCE CRITERIA

Acceptability of the CVCS and BRS design, as described in the applicant's safety analysis report (SAR), is based on specific general design criteria, regulations,[41] and the positions of regulatory guides listed below.

The ~~CMEB~~EMCB[42] acceptance criteria are based on meeting the requirements of the following regulations:

A. General Design Criterion 1, as it relates to system components being assigned quality group classifications and application of quality standards in accordance with the importance of the safety function to be performed. Acceptance is based on meeting the guidance in Regulatory Guide 1.26.

B. General Design Criterion 2, as it relates to structures housing the facility and the system itself being capable of withstanding the effects of earthquakes. Acceptance is based on meeting the guidance of Regulatory Guide 1.29, Position C.1, for safety-related portions of the system and Position C.2 for nonsafety-related portions.

C. General Design Criterion 5, as[43] it relates to shared systems and components important to safety being capable of performing required safety functions.

D. General Design Criterion 14, as it relates to assuring reactor coolant pressure boundary material integrity by means of the CVCS being capable of maintaining reactor coolant system water chemistry necessary to meet PWR reactor coolant system water chemistry technical specifications.

E. General Design Criterion 29, as it relates to the reliability of the CVCS to provide negative reactivity to the reactor by supplying borated water to the reactor coolant system in the event of anticipated operational occurrences.

F. General Design Criteria 33 and 35 as they relate to the CVCS capability to supply reactor coolant makeup in the event of small breaks or leaks in the reactor coolant pressure boundary, to function as part of ECCS assuming a single active failure coincident with the loss of offsite power, and to meet ECCS technical specifications.

G. General Design Criteria 60 and 61 as they relate to CVCS components having provisions for venting and draining through closed systems.

H. TMI Action Plan item III.D.1.1 of NUREG-0737, equivalent to 10 CFR 50.34(f)(2)(xxvi) for applicants subject to 10 CFR 50.34(f), with respect to the provisions for a leakage detection and control program to minimize the leakage from those portions of the CVCS system outside of the containment that contain or may contain radioactive material following an accident.[44]

I. 10 CFR 50.63, "Loss of All Alternating Current Power," paragraph (a)(2), in regard to the ability of the CVCS systems to provide sufficient capacity and capability to ensure that the core is cooled in the event of a station blackout.[45] If the CVCS system is necessary to support a plant SBO withstand or coping capability as required by 10 CFR 50.63, the positions in Regulatory Guide 1.155 regarding CVCS system design provide an acceptable method for showing compliance.[46]

Other specific criteria used to review the CVCS and BRS design follows.

1. The CVCS should include provisions for monitoring:

    a. temperature upstream of the demineralizer to assure that resin temperature limits are not exceeded, and

    b. filter demineralizer differential pressure to assure that pressure differential limits are not exceeded.

2. The CVCS should have provision for automatically diverting or isolating the CVCS flow to the demineralizer in the event the demineralizer influent temperature exceeds the resin temperature limit.

~~3. A program is implemented to leakage from the makeup and letdown lines in accordance with Item III.D.1.1 of NUREG-0737 for OL applications and III.D.1.1 of NUREG-0718 for CP applications.~~ [47]

Technical Rationale:[48]

The application of the above acceptance criteria to the chemical and volume control systems is addressed in the following paragraphs.

1. GDC 1 requires that structures, systems, and components (SSCs) important to safety be designed, fabricated, erected and tested to quality standards commensurate with the importance of the safety functions to be performed. The CVCS may be important to safety in that: 1) the CVCS may be capable of emergency boration during a safety injection to a reactor coolant system (RCS) boron concentration that exceeds the requirements for safe shutdown; 2) the CVCS may provide a means of makeup for the RCS coolant inventory in the event of small leaks; 3) portions of the CVCS may provide seal water to the reactor coolant pump (RCP) components important to safety; 4) the CVCS may be capable of borating the RCS to a safe cold shutdown condition; 5) the CVCS is relied upon to control RCS water chemistry to maintain the integrity of the RCS pressure boundary; 6) through connections to the RCS a CVCS failure could adversely affect the integrity of the RCS or containment systems; and 7) portions of the CVCS contain or may contain radioactive material. Meeting the requirements of GDC 1 and Regulatory Guide 1.26 ensures that the CVCS will be designed, fabricated, erected and tested to generally accepted and recognized codes and standards that are sufficient to assure a quality system in keeping with the importance of the designated safety functions.

2. GDC 2 requires that SSCs important to safety be designed to withstand the effects of natural phenomena without the loss of capability to perform their safety functions. Certain portions of the CVCS may have functions important to plant safety that should be designed to withstand the safe shutdown earthquake (SSE). Regulatory Guide 1.29 provides guidance for determining which systems should be designated Seismic Category I; position C.1 provides guidance for safety related portions and position C.2 provides guidance for nonsafety related portions. For example, the CVCS connects to the RCS, and components that form interfaces between Seismic Category I and non-Seismic Category I features should be designed to Seismic Category I requirements. Meeting the requirements of GDC 2 and Regulatory Guide 1.29 will enhance plant safety by ensuring the integrity of Seismic Category I portions of the system during a design basis seismic event.

3. GDC 5 prohibits the sharing of SSCs among nuclear power units unless it can be shown that such sharing will not significantly impair their ability to perform their safety functions, including, in the event of an accident in one unit, and orderly shutdown and cooldown of the remaining units. The CVCS may be designed to provide essential

safety-related functions necessary for continued safe operation of the unit(s), such as the ability to provide seal injection to the RCPs or the capability to maintain RCS chemistry to prevent gross failure of the reactor coolant pressure boundary. The CVCS must be designed such that the ability to perform these and other designated safety-related functions are not compromised for each unit regardless of equipment failures or other events that may occur in another unit. Meeting the requirements of GDC 5 provides assurance that unacceptable effects of equipment failures or other events occurring in one unit of a multi-unit site will not propagate to the unaffected unit(s).

4. GDC 14 requires assurance that the reactor coolant pressure boundary will have an extremely low probability of abnormal leakage, of rapidly propagating failure and of gross rupture. Failure of the reactor coolant pressure boundary may be postulated where the mechanisms of general corrosion and/or stress corrosion cracking induced by impurities in the reactor coolant are present. Acceptable purity levels in the reactor coolant are maintained by the CVCS system through the removal of insoluble corrosion products by filtration and through the removal of dissolved ionic material by ion exchange. In addition, the CVCS maintains proper RCS chemistry by allowing for the control of total dissolved solids, pH, oxygen concentration and halide concentrations within the acceptable ranges. Meeting the requirements of GDC 14 enhances plant safety by providing assurance that the probability of corrosion-induced failure of the reactor coolant pressure boundary will be minimized, thereby maintaining the integrity of the reactor coolant pressure boundary.

5. GDC 29 requires that the reactivity control systems be designed to assure an extremely high probability of accomplishing their safety functions in the event of anticipated operational occurrences. Portions of the CVCS system may be relied upon to provide negative reactivity addition by injection of boric acid to the reactor coolant system. Injection of sufficient negative reactivity by the reactivity control system assures that specified acceptable fuel design limits will not be exceeded. Meeting the requirements of GDC 29 enhances plant safety by assuring that the reactivity control aspects of the CVCS will have a high probability of injecting sufficient negative reactivity to prevent exceeding acceptable fuel design limits during anticipated operational occurrences, thereby preventing damage to the fuel matrix and cladding.

6. GDC 33 requires that a system be provided to supply reactor coolant makeup for protection against small breaks in the reactor coolant pressure boundary. The CVCS may be relied upon to provide charging and makeup in the event of small leakage from the reactor coolant pressure boundary and rupture of small piping or components that are part of the pressure boundary. Meeting the requirements of GDC 33 enhances plant safety by ensuring that the CVCS can provide sufficient makeup capacity to maintain the required RCS water inventory and prevent the violation of specified fuel design limits given a small break in the reactor coolant pressure.

7. GDC 35 requires that the ECCS safety function can be performed assuming a single component failure coincident with a loss of power. The CVCS may be relied upon to provide ECCS high head pumping capability necessary to ensure that emergency core cooling is provided during an accident. One of the functions of the CVCS is to transfer

sufficient heat from the core to prevent fuel and clad damage that could interfere with core cooling and to limit the cladding metal-water reaction to negligible amounts. Meeting the requirements of GDC 35 for the applicable portions of the CVCS enhances plant safety by ensuring that sufficient emergency core cooling is provided during design basis accidents, thereby preventing damage to the fuel and cladding that could interfere with core cooling.

8. GDC 60 requires that the release of radioactive material to the environment be controlled. The CVCS during normal reactor operation can contain radioactive material in gaseous and liquid forms. The CVCS is designed with storage tanks to handle venting and draining from various CVCS systems. The CVCS vent and drain systems are designed to appropriately confine the radioactivity associated with the effluents. Meeting the requirements of GDC 60 enhances plant safety by preventing the uncontrolled release of radioactive material to the environment.

9. GDC 61 requires that systems that may contain radioactivity be designed to assure adequate safety under normal and postulated accident conditions. The CVCS system is connected to the RCS and during normal and postulated accident conditions may contain radioactivity throughout the system. Meeting the requirements of GDC 61 ensures that applicable portions of the CVCS are designed to provide confinement of radioactive material and to reduce the potential exposure to radioactive materials to the lowest practical levels.

10. 10 CFR 50.63 establishes requirements on the plant regarding the capability to ensure that the core is cooled in the event of a station blackout for a specific duration. The CVCS system is capable of providing core cooling to the reactor core through coolant charging and letdown functions. In addition, the CVCS provides coolant makeup and RCP seal injection. Regulatory Guide 1.155 identifies guidance and acceptable methods for complying with the requirements of 10 CFR 50.63. Compliance with this Regulatory Guide and 10 CFR 50.63 provides assurance that the CVCS systems are capable of performing their intended functions to support core cooling in the event of a station blackout.

III. REVIEW PROCEDURES

The procedures below are used during the construction permit (CP) review to determine that the design criteria and bases and the preliminary design as set forth in the preliminary safety analysis report meet the acceptance criteria given in subsection II. For the review of operating license (OL) applications, the procedures are utilized to verify that the initial design criteria and bases have been appropriately implemented in the final design as set forth in the final safety analysis report.

The procedures for OL applications include a determination that the content and intent of the technical specifications prepared by the applicant are in agreement with the requirements for system testing, minimum performance, and surveillance developed as a result of the staff's review.

Upon request from the primary reviewer, the coordinated review branches will provide input for the areas of review stated in subsection I. The primary reviewer obtains and uses such inputs as required to assure that this review ~~procedure~~[49] is complete.

For the purpose of this SRP section, a typical system is assumed for use as a guide since the design of the CVCS will vary with each reactor plant supplier. It is assumed that the typical system consists of a regenerative heat exchanger to cool the letdown flow from the RCS before processing through the demineralizers and to reheat it prior to reinjection into the RCS, demineralizers, and filters for removal of suspended and dissolved impurities, high pressure charging pumps to inject makeup flow into the RCS, a volume control tank for system surge capacity and makeup volume, a boron makeup and storage system to provide neutron absorber to the RCS as needed, evaporators and tanks for boron recovery and demineralized water makeup, and a boron thermal regeneration subsystem to minimize the quantity of waste water and allow reactivity control by varying the temperature of demineralizers so as to remove or add boron to the CVCS. For cases where there are variations from this system, the reviewer would adjust the review procedures given below. However, the system design would be required to meet the acceptance criteria given in subsection II.

A. The SAR is reviewed to determine that the system description and piping and instrumentation diagrams (P&IDs) show the CVCS equipment that is used for normal operation, and the minimum system heat transfer and flow requirements for normal plant operation. The system performance requirements will also be reviewed to determine that it limits expected component operational degradation (e.g., pump leakage, heat exchanger scaling, resin deterioration) and describes the procedures that will be followed to detect and correct these conditions when they become excessive. The reviewer, using the results of failure modes and effects analyses, comparisons with previously approved systems, or independent calculations, as appropriate, determines that the system can sustain the loss of any active component and meet the minimum system requirements for plant shutdown or accident mitigation. The system P&IDs, layout drawings, and component descriptions and characteristics are then reviewed for the following points:

   1. Essential portions of the CVCS are correctly identified and are verified to be isolable from the nonessential portions of the system and from interfacing systems such as demineralized water makeup and radioactive waste systems. The P&IDs will be reviewed to verify that they clearly indicate physical divisions between such portions and indicate design classification changes. Systems drawings are also reviewed to see that they show the means for accomplishing isolation and the system description is reviewed to identify minimum performance requirements for the isolation valves.

   2. ~~CMEB~~ EMCB[50] coordinates with ~~MEB~~ EMEB[51] to assure that essential portions of the CVCS, including the isolation valves separating essential portions from nonessential portions are classified Quality Group A, B, or C and seismic Category I in accordance with the guidelines of Regulatory Guides 1.26 and 1.29; also, system descriptions in the SAR are reviewed to verify that the above seismic and safety classifications have been included, and that the P&IDs indicate any points of change in piping quality group classification.

3. The failure of portions of the system or of other systems not designed to seismic Category I standards and located close to essential portions of the system, or of nonseismic Category I structures that house, support, or are close to essential portions of the CVCS, will not preclude operation of the essential portions of the CVCS (Position C.2 of Regulatory Guide 1.29). Reference to SAR sections describing site features and the general arrangement and layout drawings will be necessary, as well as the SAR tabulation of seismic design classifications for structures and systems. Statements in the SAR that verify that the above conditions are met are acceptable (CP).

4. Using the results of evaluations performed by ~~CPB~~SRXB[52], the ~~CMEB~~EMCB[53] verifies the adequacy of the system for reactivity control in the following areas:

   a. Boration of the reactor coolant system is accomplished through either of two flow paths and from either of two boric acid sources, and CVCS meets PWR boration technical specifications. This is verified from the review of P&IDs and system description.

   b. The amount of boric acid stored in the CVCS exceeds the amount required to borate the reactor coolant system to cold shutdown concentration, assuming that the control assembly with the highest reactivity worth is held in the fully withdrawn position, and to compensate for subsequent xenon decay during any part of core life. This is verified by coordinating with the ~~CPB~~ SRXB[54].

5. The adequacy of the CVCS for control of water chemistry is verified by examination of the information provided in the SAR, i.e., the allowable ranges for primary coolant activity, total dissolved solids, pH, and maximum allowable oxygen and halide concentrations and verification that CVCS can meet PWR reactor coolant system water chemistry technical specifications. The reviewer verifies that primary water chemistry controls and specifications provide for compatibility with materials to be exposed to reactor coolant under the expected service conditions. The reviewer evaluates the proposed chemistry controls and specifications with respect to those described in EPRI NP-7077, "PWR Primary Water Chemistry Guidelines," (Reference 21) as supplemented by the following guidelines for the makeup water storage tank:

Conductivity at 25°C	0.2 S/cm (max)
Oxygen	0.100 ppm (max)
Chloride	0.15 ppm (max)
Fluoride	0.15 ppm (max)
Suspended solids*	1.0 ppm (max)

*Solids concentration is determined by filtration through a filter having a 0.45-micrometer (micron) pore size.[55]

6. The adequacy of resin over-temperature protection is verified by reviewing the system description and drawings to determine that temperature sensors are provided that will actuate the demineralizer bypass or isolation valves. Also, verify that instrumentation is available to monitor filter demineralizer differential pressure.

7. The boron thermal regeneration subsystem is reviewed to determine the maximum change in primary coolant boron concentration due to equipment or control errors as determined from failure modes and effects analyses.

8. The operating procedures and controls for boron addition and primary coolant dilution are reviewed for adequacy.

9. The system P&IDs are examined to determine that all components and piping that can contain boric acid will either be heat traced or will be located within heated rooms to prevent precipitation of boric acid.

10. The application is reviewed with respect to establishing a leakage control ~~reduction~~ program, for those portions of the CVCS located outside containment that may contain radioactive material following an accident, ~~in accordance~~consistent with item III.D.1.1 of NUREG-0737. ~~(OL applications) or NUREG-0718 (CP applications).~~[56]

11. The CVCS low pressure or holdup tanks that can contain primary system water are reviewed to assure adequate measures have been taken to protect against vacuum conditions that could result in tank damage (see Reference 17). With respect to the prevention of vacuum conditions in system tanks, the reviewer should consider the following: (a) tanks with a cover gas are able to admit the cover gas fast enough to keep up with the maximum rate of liquid removal; (b) vacuum relief valves are included in a surveillance program; and (c) tanks subject to freezing conditions have adequate freeze protection for the tank and the vacuum relief system.[57]

12. The reviewer verifies that the applicant has considered the following guidance regarding the design of the CVCS miniflow systems necessary to ensure safety related CVCS pump protection (References 18, 19 and 20):

    a. Ensure that the minimum cooling flow provided for the CVCS pumps is adequate under all conditions, including verification that the system configuration precludes pump-to-pump interaction during miniflow operation that could result in dead-heading one or more of the pumps. The miniflow must be sufficient to prevent damage to the pump(s) under all conditions.

    b. In cases where only the miniflow return line is available for pump testing, flow instrumentation must be installed on the miniflow return line. This instrumentation is necessary to provide flow rate measurements during

pump testing so this data can be evaluated with the measured pump differential pressure to monitor for pump hydraulic degradation.[58]

B. The reviewer verifies that the safety function of the system will be maintained as required in the event of adverse environmental phenomena such as earthquakes, tornadoes, hurricanes, and floods, or in the event of certain pipe breaks or loss of offsite power. The reviewer uses engineering judgment, failure modes and effects analyses, and the results of reviews performed under other SRP sections, as applicable, to determine the following:

1. The system description and drawings are reviewed in conjunction with the reactor coolant system to determine that the CVCS has sufficient pumping capacity to maintain the RCS water inventory within the allowable pressurizer level range for all normal modes of operation, including startup from cold shutdown, full power operation, and plant cooldown. Verify that CVCS can supply reactor coolant makeup in the event of small pipe breaks and can function as part of the ECCS, assuming a single active failure coincident with the loss of offsite power. It is further ascertained from a review of the P&IDs that makeup to the RCS can be accomplished via two redundant,[59] appropriately designed flow paths.

2. Essential components and subsystems (i.e., those necessary for safe shutdown) can function as required in the event of loss of offsite power. The system design will be acceptable if the CVCS meets minimum system requirements as stated in the SAR assuming a failure of a single active component, within the system or in the auxiliary electric power source, which supplies the system. The SAR is reviewed to verify that for each CVCS component or subsystem affected by the loss of offsite power, boric acid addition and coolant charging capabilities meet or exceed minimum requirements. Statements in the SAR and the results of failure modes and effect analyses are considered in assuring that the system meets these requirements. This will be acceptable verification of system functional reliability.

C. The descriptive information, P&IDs, layout drawings, and failure modes and effects analyses in the SAR are reviewed to assure that essential portions of the system will function following design basis accidents assuming a single active component failure. The reviewer evaluates the analyses presented in the SAR to assure function of required components, traces the availability of these components on system drawings, and checks that the SAR contains verification that minimum system flow and heat transfer requirements are met for each accident situation for the required time spans. For each case, the design will be acceptable if minimum system requirements are met.

D. The boron recovery system is not required for safe shutdown, or for the prevention or mitigation of postulated accidents. The BRS will be reviewed for the following: if the system tankage is of nonseismic Category I design, the results of analyses which postulate the rupture of tanks are reviewed by ~~AEB~~PERB[60] to verify that the accident releases are in accordance with safe limits.

E. The reviewer confirms that the CVCS system's capability is sufficient with respect to the plant's ability to withstand or cope with, as applicable, and recover from, a SBO by determining compliance with Regulatory Guide 1.155 positions C.3.2, C.3.3.4, and C.3.5. This review is coordinated with the review of the SBO event under SRP Section 8.4 (proposed).[61]

For plants/applicants that do not submit adequate test data to demonstrate the integrity of the reactor coolant pump seals during a SBO for an extended period, the reviewer verifies that there are adequate means to provide RCP seal cooling during a SBO. A diverse seal injection system, that is independent of the CVCS and associated support systems to the extent practicable, is an acceptable approach. If a diverse seal injection system is proposed by the applicant, the reviewer verifies that the system can be powered from the alternate AC power source for station blackout.[62]

For standard design certification reviews under 10 CFR Part 52, the procedures above should be followed, as modified by the procedures in SRP Section 14.3 (proposed), to verify that the design set forth in the standard safety analysis report, including inspections, tests, analysis, and acceptance criteria (ITAAC), site interface requirements and combined license action items, meet the acceptance criteria given in subsection II. SRP Section 14.3 (proposed) contains procedures for the review of certified design material (CDM) for the standard design, including the site parameters, interface criteria, and ITAAC.[63]

IV. EVALUATION FINDINGS

The reviewer verifies that sufficient information has been provided and ~~his~~the[64] review supports conclusions of the following type, to be included in the staff's safety evaluation report:

The chemical and volume control system (including boron recovery system) includes components and piping associated with the system from the letdown line of the primary system to the charging lines that provide makeup to the primary system and the reactor coolant pump seal water system. Based on the review of the applicant's proposed design criteria, design bases, and safety classification for the chemical and volume control system, and the requirements for system performance of necessary functions during normal, abnormal, and accident conditions, the staff concludes that the design of the chemical and volume control system and supporting system is acceptable and meets the requirements of General Design Criteria 1, 2, 5, 14, 29, 33, 35, 60, and 61, 10 CFR 50.34(f)(2)(xxvi)[65] and 10 CFR 50.63(a)(2).[66]

This conclusion is based on the following:[67] the applicant's design of the chemical and volume control system meets (1) the requirements of General Design Criterion 1 and the guidelines of Regulatory Guide 1.26 by assigning quality group classifications to system components in accordance with the importance of the safety function to be performed; (2) the requirements of General Design Criterion 2 and the guidelines of Regulatory Guide 1.29 by designing safety-related portions of the system to seismic Category I requirements; (3) the requirements of General Design Criterion 5 by designing the CVCS so that components important to safety are not shared between nuclear power units unless such sharing will not significantly impair the ability of the CVCS to perform its safety

functions in the event of an accident in one unit and an orderly shutdown and cooldown of the remaining units; (4) the requirements of General Design Criterion 14 by maintaining reactor coolant purity and material compatibility to reduce corrosion and thus reduce the probability of abnormal leakage, rapid propagating failure, or gross rupture of the reactor coolant pressure boundary; (5) the requirements of General Design Criterion 29 as related to the reliability of the CVCS to provide negative reactivity to the reactor by supplying borated water to the reactor coolant system in the event of anticipated operational occurrences; (6) the requirements of General Design Criteria 33 and 35 by designing the CVCS with the capability to supply reactor coolant makeup in the event of small breaks or leaks in the reactor coolant pressure boundary and to function as part of ECCS assuming a single failure coincident with loss of offsite power; (7) the requirements of General Design Criteria 60 and 61 with respect to confining radioactivity by venting and collecting drainage from the CVCS components through closed systems; ~~and~~ [68](8) the provisions of III.D.1.1 of NUREG-0737, equivalent to 10 CFR 50.34(f)(2)(xxvi) for applicants subject to 10 CFR 50.34(f), with respect to leakage detection and control in the design of CVCS systems outside containment that contain (or may contain) radioactive material following an accident ~~(OL) or NUREG-0718 (CP) as it relates to establishing a leak reduction program~~[69]; and (9) the relevant requirements of 10 CFR 50.63(a)(2) and the guidance of Regulatory Guide 1.155 positions C.3.2, C.3.3.4, and C.3.5 by demonstrating the capability of the CVCS to support the plant's ability to withstand or cope with, and recover from a station blackout. Conformance with 10 CFR 50.63 requirements for station blackout is discussed in further detail in Section 8.4 of this report.[70]

For design certification reviews, the findings will also summarize, to the extent that the review is not discussed in other safety evaluation report sections, the staff's evaluation of inspections, tests, analyses, and acceptance criteria (ITAAC), including design acceptance criteria (DAC), site interface requirements, and combined license action items that are relevant to this SRP section.[71]

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plans for using this SRP section.

This SRP section will be used by the staff when performing safety evaluations of license applications submitted by applicants pursuant to 10 CFR 50 or 10 CFR 52.[72] Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the method described herein will be used by the staff in its evaluation of conformance with Commission regulations. The guidelines for primary water chemistry described in subsection III.A.5 are used for the evaluation of new applications.[73] Also, pending further regulatory action (e.g., issuance of an approved Regulatory Guide) to resolve Generic Safety Issues with respect to the integrity of reactor coolant pump seals, the method for review of the adequacy of the reactor coolant pump seal integrity for station blackout described in subsection III.E is used for the evaluation of new applications.[74]

The provisions of this SRP section apply to reviews of applications docketed six months or more after the date of issuance of this SRP section.[75]

Implementation schedules for conformance to parts of the method discussed herein are contained in the referenced regulatory guides.

VI. REFERENCES[76]

1. 10 CFR Part 50, §50.34(f), "Additional TMI-Related Requirements."[77]

2. 10 CFR 50, §50.63, "Loss of All Alternating Current Power."[78]

~~1~~3. 10 CFR Part 50, Appendix A, General Design Criterion 1, "Quality Standards and Records."

~~2~~4. 10 CFR Part 50, Appendix A, General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena."

~~3~~5. 10 CFR Part 50, Appendix A, General Design Criterion 5, "Sharing of Structures, Systems, and Components."

~~4~~6. 10 CFR Part 50, Appendix A, General Design Criterion 14, "Reactor Coolant Pressure Boundary."

~~5~~7. 10 CFR Part 50, Appendix A, General Design Criterion 29, "Protection Against Anticipated Operational Occurrences."

~~6~~8. 10 CFR Part 50, Appendix A, General Design Criterion 33, "Reactor Coolant Makeup."

~~7~~9. 10 CFR Part 50, Appendix A, General Design Criterion 35, "Emergency Core Cooling."

~~8~~10. 10 CFR Part 50, Appendix A, General Design Criterion 60, "Control of Release of Radioactive Material to the Environment."

~~9~~11. 10 CFR Part 50, Appendix A, General Design Criterion 61, "Fuel Storage and handling and Radioactivity Control."

1~~0~~2. Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants."

1~~1~~3. Regulatory Guide 1.29, "Seismic Design Classification."

14. Regulatory Guide 1.155, "Station Blackout."[79]

1~~2~~5. NUREG-0737, "Clarification of TMI Action Plan Requirements.

16. NUREG-0718, "Licensing Requirements for Pending Applications for Construction Permits and Manufacturing Licenses."

17. NRC Letter to All Operating Reactor Licensees, "Vacuum Condition Resulting in Damage to Chemical Volume Control System (CVCS) Holdup Tanks (Sometimes Called 'Clean Waste Receiver Tanks')(Generic Letter 80-21)," March 10, 1980.[80]

18. NRC Letter to All Holders of Light Water Reactor Operating Licenses and Construction Permits, "Guidance on Developing Acceptable Inservice Testing Programs (Generic Letter 89-04)," April 3, 1989.[81]

19. NRC Bulletin 80-18, "Maintenance of Adequate Minimum Flow Thru Centrifugal Charging Pumps Following Secondary Side High Energy Line Rupture," July 24, 1980.[82]

20. NRC Bulletin 88-04, "Potential Safety-Related Pump Loss," May 5, 1988.[83]

21. EPRI NP-7077, "PWR Primary Water Chemistry Guidelines," Revision 2, dated November 1990, Electric Power Research Institute.[84]

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SRP Draft Section 9.3.4
Attachment A - Proposed Changes in Order of Occurrence

Item numbers in the following table correspond to superscript numbers in the redline/strikeout copy of the draft SRP section.

Item	Source	Description
1.	SRP-UDP Format Item, Update PRB names.	Changed PRB name to reflect latest primary review responsibility assignments for SRP section 9.3.4.
2.	Current PRB names and abbreviations.	Added the Plant Systems Branch (SPLB) and the Reactor Systems Branch (SRXB) as the branches with secondary review responsibility. This is consistent with the current review branch responsibility assignments.
3.	**Integrated Impact # 429.**	Added a reference to 10 CFR 50.63 paragraph (a)(2) in the Areas of Review. This reference is necessary to address the capability of the CVCS systems to provide reactor coolant pump seal injection and support core inventory control following a station blackout event.
4.	SRP-UDP Format Item, Update PRB names.	Changed PRB name to reflect latest responsibility assignments for SRP section 9.3.4.
5.	**Integrated Impact #427**	A new area of review was added to address the new review procedures being added as a result of this integrated impact. A review procedure covering the system provisions taken to protect the CVCS system tanks against vacuum conditions has been added to incorporate the guidance found in NRC Generic Letter 80-021 and NRC Bulletin 80-05. The added area of review is consistent with this new review procedure.
6.	SRP-UDP Format Item, Reformat Areas of Review.	This sentence was moved to the new Review Interfaces subsection.
7.	SRP-UPD format item, Reformat Areas of Review.	Added "Review Interfaces" heading to Areas of Review. Reformatted and reordered existing description of review interfaces in numbered paragraph format to describe how EMCB coordinates other evaluations that interface with the overall review of the system.
8.	SRP-UPD format item, Reformat Areas of Review.	Revised the introduction to the review interface section to be consistent with the SRP-UDP format for this sub-section.
9.	SRP-UDP Format Item, Update PRB names.	The PRB name was changed to reflect latest responsibility assignments for SRP Sections 3.4.1 and 9.3.3. Use of the term "also" was removed due to the reordering of the review interfaces.
10.	SRP-UDP Format Item, Update PRB names.	The PRB name was changed to reflect latest responsibility assignments for SRP Sections 3.5.1.1 and 3.5.1.2. Use of the term "also" was removed due to the reordering of the review interfaces.

Item	Source	Description
11.	SRP-UDP Format Item, Update PRB names.	The PRB name was changed to reflect latest responsibility assignments for SRP Sections 3.5.1.4 and 3.5.2. Use of the term "also" was removed due to the reordering of the review interfaces.
12.	SRP-UDP Format Item, Update PRB names.	The PRB name was changed to reflect latest responsibility assignments for SRP Section 3.6.1.
13.	SRP-UDP Format Item, Reformat Areas of Review	Moved the environmental qualification reviews performed under SRP Section 3.11 to the list for SPLB.
14.	**PI # 23840**	Added a review interface with SRP Section 9.2.2 for review of RCP seal integrity issues. The CVCS system in PWRs may be designed to provide injection to the reactor coolant pump seals. This injection water provides necessary cooling to prevent seal failure and a subsequent loss of reactor coolant. TMI Action Items II.K.2.16 and II.K.3.25 address reactor coolant pump seal cooling issues and are reviewed under SRP Section 9.2.2. Generic Issue 23 also deals with RCP seal integrity issues and is the subject of ROC 503 assigned to SRP Section 9.2.2.
15.	SRP-UDP Format Item, Update PRB names.	This review interface to SRP section 9.5.1 was moved from the first sentence of item B. This review interface was formerly the responsibility of the old CMEB. The PRB name has been changed to reflect latest responsibility assignments for SRP Section 9.5.1.
16.	SRP-UDP Format Item, Update PRB names.	The PRB name has been changed to reflect the latest responsibility assignments for SRP Sections 11.2, 11.3, and 11.4. The radiological monitoring aspects of this review interface performed under SRP section 11.5 were moved to a separate review interface. This separate review interface is now the responsibility of the Emergency Preparedness and Radiation Protection Branch (PERB).
17.	**Integrated Impact # 428**	Added an Areas of Review to address the reviews regarding interfacing systems LOCA to be contained in proposed new SRP Section 3.12. The review of the proposed new SRP Section will be conducted by the SRXB.
18.	SRP-UDP Format Item, Update PRB names.	Changed PRB name to reflect latest responsibility assignments for SRP Section 4.3. The Reactor Systems Branch is now the responsible branch for SRP Section 4.3.
19.	SRP-UDP Format Item, Update PRB names.	Changed the PRB name to reflect latest responsibility assignments for SRP Sections 6.3, 15.6.1, and 15.6.5.
20.	SRP-UDP Format Item, Update PRB names.	Changed PRB name to reflect latest responsibility assignments for SRP Section 15.4.6.

Item	Source	Description
21.	SRP-UDP Format Item, Update PRB names.	A separate review interface covering the radiological monitoring aspects of the CVCS was generated. A separate review interface was necessary because the PERB is now the Primary Review Branch responsible for SRP Section 11.5.
22.	SRP-UDP Format Item, Update PRB names.	The PRB name was changed to reflect latest responsibility assignments for SRP Sections 12.1 and 12.3.
23.	SRP-UDP Format Item, Update PRB names.	The PRB name was changed to reflect latest PRB designator for SRP Sections 7.1, 7.6, and Appendix 7A.
24.	SRP-UDP Format Item, Reformat Areas of Review	Split the review interface discussion for HICB and EELB into two separate review interfaces. This portion addresses instrumentation and controls reviewed under SRP Sections 7.1, 7.6 and Appendix 7A.
25.	SRP-UDP Format Item, Update PRB names.	The PRB name was changed to reflect latest PRB designator for SRP Section 8.3.1.
26.	SRP-UDP Format Item, Reformat Areas of Review	Split the review interface discussion for HICB and EELB into two separate review interfaces. This portion addresses electrical systems reviewed under SRP Sections 8.3.1 (ac) and 8.3.2 (dc).
27.	**Integrated Impact # 429.**	Revised Areas of Review (review interfaces) to include reference to 10 CFR 50.63. The Station Blackout Rule provides additional criteria applicable to the CVCS system and is designated to be reviewed primarily in SRP Section 8.3.1.
28.	SRP-UDP Format Item, Update PRB names.	The PRB name was changed to reflect latest responsibility assignments for SRP Sections 3.3.1, 3.3.2, 3.4.2, 3.5.3, 3.7.1, 3.7.2, 3.7.3, 3.8.4, and 3.8.5.
29.	SRP-UDP Format Item, Update PRB names and abbreviations.	Changed PRB designation to reflect latest responsibility assignments for SRP Sections 5.2.4 and 6.6.
30.	SRP-UDP format item, Reformat Areas of Review.	This review interface discussing the reviews formerly performed by MTEB was moved from the areas of review into the new review interfaces subsection. The ECGB is currently responsible for these reviews.
31.	SRP-UDP Format Item, Update PRB names.	The PRB name was changed to reflect latest responsibility assignments for SRP Sections 3.2.1 and 3.2.2.
32.	SRP-UDP Format Item, Update PRB names.	The PRB name was changed to reflect latest PRB designator for SRP Sections 3.9.1, 3.9.2, and 3.9.3. Use of the phrase "also" was removed due to the reordering of the review interfaces.

Item	Source	Description
33.	SRP-UDP Format Item, Update PRB names.	Changed PRB name to reflect latest responsibility assignments for SRP Section 3.9.6. Use of the phrase "also" was removed due to the reordering of the review interfaces.
34.	SRP-UDP Format Item, Update PRB names.	The PRB name was changed to reflect latest responsibility assignments for SRP Section 3.10.
35.	SRP-UDP Format Item, Reformat Areas of Review	Moved the discussion of the review interface for SRP Section 3.11 to the review interfaces listed for the SPLB.
36.	SRP-UDP Format Item, Update PRB names.	PRB name was changed to reflect latest responsibility assignments for SRP Section 6.2.4.
37.	SRP-UDP Format Item, Update PRB names.	The PRB name was changed to reflect latest responsibility assignments for SRP Section 16.0.
38.	SRP-UDP Format Item, Reformat Areas of Review	Split up the review interfaces for HQMB and TSB. This review interface address the technical specification reviews under SRP Section 16.0.
39.	SRP-UDP Format Item, Reformat Areas of Review	Split up the review interfaces for HQMB and TSB. This review interface address the quality assurance reviews under SRP Sections 17.1 and 17.2.
40.	SRP-UDP Format Item, Reformat Areas of Review	Revised the conclusion paragraph to address SRP Sections rather than the other PRB branches, making the statement inclusive of the EMCB.
41.	**Integrated Impact # 429.**	This is an editorial change to complete the list of the types of acceptance criteria. 10 CFR 50.63(a)(2) was added as acceptance criteria to address station blackout requirements in regard to CVCS.
42.	SRP-UDP Format Item, Update PRB names.	The PRB name was changed to reflect latest responsibility assignments for this SRP Section.
43.	Editorial	Added "as" to improve grammar per a PRB comment.

Item	Source	Description
44.	**Integrated Impact # 1013**	10 CFR 50.34(f)(2)(xxvi) including the requirements of Item III.D.1.1 of NUREG-0737 was added to the Acceptance Criteria (III.D.1.1 was formerly addressed in the specific criteria section). This criteria establishes the provisions for leakage detection and control in the design of those systems outside of containment that contain or may contain radioactive materials following an accident. Citation in the Acceptance Criteria of both the 10 CFR 50.34(f)(2)(xxvi) requirements and the requirements contained in NUREG-0737 Item III.D.1.1 bounds the applicability of this issue to the necessary license applicants without the need to discuss applicability issues in the Acceptance Criteria. Existing operating licenses are bounded by their individual responses and commitments to NUREG-0737 Item III.D.1.1. Design Certification applicants and construction permit applicants are bound through 10 CFR 52 and 10 CFR 50.34(f)(2)(xxvi) respectively.
45.	**Integrated Impact # 429.**	Added the acceptance criteria for 10 CFR 50.63 paragraph (a)(2) to the Acceptance Criteria. 10 CFR 50.63(a)(2) is the requirement regarding the ability of the CVCS systems to provide sufficient capacity and capability during a station blackout event.
46.	**Integrated Impact # 429.**	Added a paragraph in the specific criteria section of the acceptance criteria to address the guidance of Regulatory Guide 1.155. Regulatory Guide 1.155 provides acceptable methods for showing compliance with the requirements of 10 CFR 50.63(a)(2) on SBO for applicable portions of the CVCS system.
47.	**Integrated Impact # 1013**	The Acceptance Criteria (specific criteria) that addresses item III.D.1.1 of NUREG-0737 was moved to item II.H to include the addition of 10 CFR 50.34(f)(2)(xxvi). 10 CFR 50.34(f)(2)(xxvi) is the corresponding regulatory citation to NUREG-0737 item III.D.1.1. To eliminate duplication, III.D.1.1 was removed from the specific criteria section.
48.	SRP-UDP format item, adding technical rationale.	Technical rationale were developed and added for the following Acceptance Criteria: GDCs 1,2,5,14,29,33,35,60,61 and 10 CFR 50.63.
49.	SRP-UDP Format Item, Editorial	Removed the word "procedure" as it in redundant and unnecessary.
50.	SRP-UDP Format Item, Update PRB names.	The PRB name was changed to reflect latest responsibility assignments for this SRP Section.
51.	SRP-UDP Format Item, Update PRB names.	The PRB name was changed to reflect latest responsibility assignments for SRP Section 3.2.2.

Item	Source	Description
52.	SRP-UDP Format Item, Update PRB names.	The PRB name was changed to reflect latest responsibility assignments for SRP Section 4.3.
53.	SRP-UDP Format Item, Update PRB names.	The PRB name was changed to reflect latest responsibility assignments for this SRP Section.
54.	SRP-UDP Format Item, Update PRB names.	The PRB name was changed to reflect latest responsibility assignments for SRP Section 4.3.
55.	**Integrated Impact # 1279**	Added a Review Procedure to review the guidelines for PWR primary water chemistry. The guidelines for PWR primary water chemistry can be found in EPRI NP-7077, "PWR Primary Water Chemistry Guidelines," Revision 2 and as supplemented by the NRC staff FSER for the EPRI URD. The changes list supplemental information from the EPRI Evolutionary URD FSER rather than referencing the FSER documenting the staff's review of the URD to minimize the explicit discussion of "evolutionary plants" and previously developed SERs in the SRP.
56.	**Integrated Impact # 1013**	This is an editorial revision to make the Review Procedure statements consistent with the Acceptance Criteria on leakage control programs. Only minor changes in terminology were made such as replacing "leak reduction" with "leakage control" since leak reduction is only one aspect of the leakage control program. In addition, a complete description of the applicable portions of the CVCS system was added for consistency. The reference to the applicable licensees and to NUREG-0718 was removed as they are redundant to the information provided by the regulations listed in the Acceptance Criteria.
57.	**Integrated Impact # 427**	A new review procedure was added to review the provisions provided to preclude the formation of vacuum conditions in CVCS tanks that can contain primary coolant. This review procedure is consistent with the NRC staff guidance on vacuum protection provided in NRC Generic Letter 80-21, "Vacuum Condition Resulting in Damage to Chemical Volume Control System (CVCS) Holdup Tanks (Sometimes Called 'Clean Waste Receiver Tanks')."
58.	**Integrated Impact # 430.**	Added a new review procedure to address the reviews necessary to verify proper design of the miniflow systems required to ensure CVCS pump protection. The guidance provided is consistent with the NRC staff positions as described in NRC Bulletins 88-04 and 80-18 and as described in Generic Letter 89-04, "Guidance on Developing Acceptable Inservice Testing Programs."
59.	SRP-UDP Format Item, Editorial	Added a comma to correct grammar error.

Item	Source	Description
60.	SRP-UDP Format Item, Update PRB Names.	The PRB name was revised to reflect the current PRB designator for this issue.
61.	**Integrated Impact # 429.**	Added a new Review Procedure to address the capability of the CVCS systems in regard to coping with and recovering from a SBO event. Compliance with the guidance contained in Regulatory Guide 1.155 positions C 3.2, 3.3.4 and 3.5 is specified. These positions cover the evaluation of plant-specific SBO capability, modifications to cope with a SBO, and QA and specification guidance for equipment that is not safety-related.
62.	**Integrated Impact # 431.**	Added a review procedure to address the staff positions regarding a design that provides for independent RCP seal injection during station blackout or to provide adequate testing of the proposed seal design to demonstrate integrity following extended loss of seal injection and cooling. The guidance included here is consistent with the staff positions described in the ABB-CE80+ FSER.
63.	SRP-UDP Guidance, Implementation of 10 CFR 52	Added standard paragraph to address application of Review Procedures in design certification reviews.
64.	SRP-UDP Format Item, Editorial.	To make the introductory sentence gender neutral "his" was replaced with "the."
65.	**Integrated Impact # 1013**	Added 10 CFR 50.34(f)(2)(xxvi) to the list of Acceptance Criteria to make the Evaluation Findings consistent with the Acceptance Criteria.
66.	**Integrated Impact # 429.**	Added 10 CFR 50.63(a)(2) to the list of requirements to address the acceptance criteria for SBO.
67.	SRP-UDP Format Item, Editorial.	The Evaluation Findings paragraph was separated into two paragraphs to improve readability.
68.	SRP-UDP Format item, Editorial	After adding a new item (9) to the list of Evaluation Findings, the "and" was deleted to make the sentence grammatically correct.
69.	**Integrated Impact # 1013**	Added an Evaluation Finding to address the requirements of 10 CFR 50.34(f)(2)(xxvi) and the requirements of item III.D.1.1 of NUREG-0737 regarding leakage detection and control for the CVCS systems located outside of containment that contain or may contain radioactive material. The reference to the applicable licensees and to NUREG-0718 was removed as they are redundant to the information provided by the regulations listed in the Acceptance Criteria.

Item	Source	Description
70.	**Integrated Impact # 429.**	Added a new item number 9 to the conclusion statements of the Evaluation Findings to address the requirements and guidance of 10 CFR 50.63(a)(2) and Regulatory Guide 1.155 positions C 3.2, 3.3.4, and 3.5 with respect to the capability of the CVCS system to provide the necessary support to cope with and recover from a SBO event.
71.	10 CFR 52 applicability issue.	Added a discussion paragraph in the Evaluation Findings addressing the applicability of the procedures to design certification (DC) and combined license applications.
72.	SRP-UDP Guidance, Implementation of 10 CFR 52	Added standard sentence to address application of the SRP section to reviews of applications filed under 10 CFR Part 52, as well as Part 50.
73.	**Integrated Impact 1279**, implementation of new/evolutionary plant issues	Added implementation information related to the evaluation of primary water chemistry using the EPRI guidelines as supplemented in a manner acceptable to the staff.
74.	**Integrated Impact 431**, SRP-UDP Integration of SBO/Evolutionary Plant Issues	Since subsection III.E is based upon positions stated in the CE System 80+ FSER but not officially imposed on currently operating plants as part of the resolution of GSI 23 (not resolved for current plants), added clarification that the procedure is applicable to new applications only.
75.	SRP-UDP Guidance	Added standard paragraph to indicate applicability of this section to reviews of future applications.
76.	Editorial.	Renumbered and formatted references to allow for the inclusion of new references.
77.	**Integrated Impact # 1013**	Added a reference to 10 CFR 50.34(f), “Additional TMI-Related Requirements” to address the citation of the TMI item under this section of the CFR.
78.	**Integrated Impact # 429.**	Added a new reference covering 10 CFR 50.63, "Loss of All Alternating Current Power."
79.	**Integrated Impact # 429.**	Added a reference covering Regulatory Guide 1.155, "Station Blackout."
80.	**Integrated Impact # 427**	A new reference was added for Generic Letter 80-21, "Vacuum Condition Resulting in Damage to Chemical Volume Control System (CVCS) Holdup Tanks (Sometimes Called "Clean Waste Receiver Tanks)." This Generic Letter contains detailed guidance for the provisions necessary to prevent the formation of vacuum conditions in CVCS tanks.

Item	Source	Description
81.	**Integrated Impact # 430.**	Added a reference covering Generic Letter 89-04, "Guidance on Developing Acceptable Inservice Testing Programs." This Generic Letter contains guidance on the design of the miniflow systems for the CVCS.
82.	**Integrated Impact # 430.**	Added a reference to NRC Bulletin 80-18, "Maintenance of Adequate Minimum Flow Thru Centrifugal Charging Pumps Following Secondary Side High Energy Line Rupture." This Bulletin contains staff guidance and recommended actions to be taken to preclude the loss of pumps due to configurations that lead to a lack of miniflow.
83.	**Integrated Impact # 430.**	Added a reference to NRC Bulletin 88-04, "Potential Safety-Related Pump Loss." This Bulletin contains staff guidance and recommended actions to be taken to preclude the loss of pumps due to configurations that do not preclude pump-to-pump interaction during miniflow operation.
84.	**Integrated Impact # 1279**	Added a reference to EPRI NP-7077, "PWR Primary Water Chemistry Guidelines."

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Integrated Impact No.	Issue	SRP Subsections Affected
427	Add Review Procedures to address the provisions to preclude the formation of vacuum conditions in the low pressure and hold up tanks that could result in tank damage and the resultant release of radioactive material.	AREAS OF REVIEW: Added new step 6. REVIEW PROCEDURES: Added new step A.11. REFERENCES: Added reference number 17.
428	This II addressed ISLOCA concerns. ISLOCA reviews will be addressed in a proposed new SRP section 3.12.	AREAS OF REVIEW: added a review interface step 2.a for SRXB to a proposed new SRP Section 3.12.
429	Add Acceptance Criteria, Review Procedures and Evaluation Findings to address the requirements 10 CFR 50.63(a)(2) and the guidance of Regulatory Guide 1.155 relating to a station blackout event due to a loss of all AC power. Evaluation of the CVCS in regard to its support functions in coping with and recovering from a station blackout event is necessary to show compliance with the requirements and guidance.	AREAS OF REVIEW: Modified introductory paragraph and review interface for EELB. ACCEPTANCE CRITERIA: Added new step I. REVIEW PROCEDURES: Added new step E. EVALUATION FINDINGS: Modified list of criteria and added new item 9 to the list of conclusion statements. REFERENCES: Added new references items 2 and 14.
430	Add a Review Procedure to address the NRC staff guidance on the proper design of the CVCS miniflow systems required to ensure CVCS pump protection.	REVIEW PROCEDURES: Added a new step 12 with sub-steps a. and b. REFERENCES: Added new reference items numbers 18, 19 and 20.
431	Modify the Review Procedures to verify the provision of a diverse seal injection system where applicable. A diverse seal injection system may be necessary if the applicant cannot demonstrate the integrity of the reactor coolant pump seals during a station blackout for an extended period.	REVIEW PROCEDURES: Added a paragraph to review procedure step E. IMPLEMENTATION: Added clarification of applicability of new review procedure step E.

1013	Update the Acceptance Criteria to reflect the requirements of 10 CFR 50.34(f)(2)(xxvi) and NUREG-0737 TMI action plan item III.D.1.1 regarding leakage detection and control.	ACCEPTANCE CRITERIA: Added step II.H and deleted specific criteria step 3. REVIEW PROCEDURES: Revised step 10. EVALUATION FINDINGS: Added 10 CFR 50.34(f)(2)(xxvi) to the list of Acceptance Criteria. Modified step (8) of the evaluation conclusions. REFERENCES: Added item 1 to the reference list.
1279	Revise the Review Procedures for review of capabilities to control the composition of primary coolant within acceptable limits.	REVIEW PROCEDURES: Added a paragraph to step A.5. IMPLEMENTATION: Added clarification of applicability of review procedure step A.5. REFERENCES: Added item 21 to the reference list.